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TITLE: RODLIKE REINFORCING ELASTIC BODY

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ABSTRACT:

PURPOSE: To obtain the subject elastic body, having a high, flexural rigidity, excellent in corrosion, weather and water resistance and useful as a crawl frame, a pier, etc., by embedding plural core materials composed of fiber-reinforced plastic rods in a bonded state in the axial direction in a rodlike rubber.

CONSTITUTION: The objective elastic body is obtained by embedding plural core materials composed of fiber-reinforced plastic (FRP) rods 2 in a mutually bonded state in the axial direction in a rubber rod 1 which is a base material.

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ROD-SHAPED REINFORCING ELASTIC MEMBER

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[There are no amendments to this patent.]

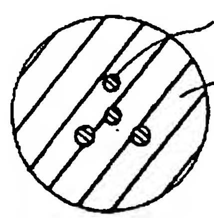
Abstract

Objective

To provide a type of rod-shaped reinforcing elastic member, which can realize the same flexural rigidity as that of a large-diameter FRP rod, yet has a higher permissible deformation degree under bending than said large-diameter FRP rod.

Constitution

A core member is composed of plural FRP rods (2) buried in rubber rod (1) as the base material, with said plural rods set in the axial direction and adhered to each other.



Key: 1 Rubber rod
2 FRP rod

Claim

A type of rod-shaped reinforcing elastic member characterized by the fact that it is prepared by burying a core member consisting of plural fiber-reinforced plastic rods in a rubber rod as the base material, with said plural fiber-reinforced plastic rods set in the axial direction and adhered to each other.

Detailed explanation of the invention

[0001]

Industrial application field

This invention pertains to a type of rod-shaped reinforcing elastic member for use in pond frames, piers, flag poles, etc.

[0002]

Prior art

In the prior art, for pond frames, piers, flag poles, etc., there is a high demand for rigidity against flexural deformation and on tolerance to bending to cope with deformation under destructive action. Consequently, bamboo, wood, plastics, and fiber-reinforced plastics (hereinafter referred to as FRP) are used.

[0003]

Problems to be solved by the invention

However, the aforementioned conventional materials have the following problems.

(1) Bamboo and wood

Bamboo or wood products have properties that depend on the site of production. Even products from the same production site may have certain differences. Consequently, it is hard to prepare them with uniform properties. Also, few bamboo/wood members can be longer than 10 m. That is, there is a limit on length. Especially, for bamboo, because the size of the root portion is different from that of the tip portion, the application range is limited. Also, since bamboo has nodes, although the overall rigidity may be high, there is a significant variation in rigidity between node portions and cylindrical portions. Consequently, when damage occurs at a site, it spreads in the axial direction. Also, when bamboo or wood members are used in water or soil for a long period of time, they become rotten.

(2) Plastics, FRP

For plastics and FRP, in order to increase the flexural rigidity, expensive reinforcing fibers should be used. Also, in order to increase the cross-sectional moment of inertia, the members should have a large diameter. However, when large-diameter members are in use, although the flexural rigidity increases, the flexural tolerance decreases, or the price rises. Although there are pipe-shaped plastics and FRP, they have the problem of buckling in case of flexural deformation. Also, there are problems related to weatherability.

[0004]

For plastics and FRP, it is well known that when plural plastic or FRP rods are adhered to form a composite body, one can realize a flexural rigidity higher than that by simply multiplying the number of rods. For example, when three plastic or FRP rods are used, if they are simply bound together, the cross-sectional moment of inertia as a parameter representing the flexural rigidity only becomes 3-fold, that is the resistance to deformation is 3-fold higher. In other

words, the bundle becomes stronger by three times, and the flexural rigidity is tripled. This has no advantage for use in pond frames, piers, flag poles, etc. On the other hand, if said three plastic or FRP rods have a base material (matrix) included between them such that the three plastic or FRP rods are adhered to form a single body, then, for the obtained single member, in case of deformation, the cross-sectional moment of inertia is 11-fold that of a single plastic or FRP rod, and the effect in forming an integrated member with respect to flexural rigidity is 11/3=3.67 times that of a 3-rod bundle without adherence.

[0005]

However, when the aforementioned example is compared with a single plastic or FRP rod with a large cross-sectional area, that is with a large diameter, the flexural tolerance becomes much lower. Also, in this example, it is necessary to ensure that the adhesive strength between the plastic or FRP and the matrix is equal to or higher than that of the matrix. The objective of this invention is to solve the aforementioned problems of conventional methods by providing a type of rod-shaped reinforcing elastic member, which can realize the same flexural rigidity as that of a large-diameter FRP rod, yet has a higher tolerance to bending than said large-diameter FRP rod.

[0006]

Means to solve the problems

In order to solve the aforementioned problem, this invention provides a type of rod-shaped reinforcing elastic member characterized by the fact that it is prepared by burying a core member consisting of plural fiber-reinforced plastic rods in a rubber rod as the base material, with said plural fiber-reinforced plastic rods set in the axial direction and adhered to each other.

[0007]

Operation

According to this invention, as a means for solving the aforementioned problem, a core member consisting of rod-shaped fiber-reinforced plastic rods is buried in a rubber rod as the base material, with said rod-shaped fiber-reinforced plastic rods set in the axial direction and adhered to each other. Consequently, a composite effect of the rubber rod and the fiber-reinforced plastic rods in increasing the flexural rigidity can be realized. Also, in addition to this advantage of the composition of the rubber rod and the fiber-reinforced plastic rods, one can realize a large cross-sectional moment of inertia, that is, one can realize a flexural rigidity

identical to that of a large-diameter fiber-reinforced plastic rod, and, one can also have a larger tolerance to bending than that of the large-diameter fiber-reinforced plastic rod.

[0008]

Application examples

In the following, this invention will be explained in more detail with reference to an application example illustrated in Figure 1. Figure 1 is a cross-sectional view of a rod-shaped reinforcing elastic member in an application example of this invention. For the rod-shaped reinforcing elastic member of this application example, in rubber rod (1) as base material (matrix), a core (core) member consisting of four fiber-reinforced plastic (hereinafter to be referred to as FRP) rods (2) treated for adhering is buried in the axial direction, with said FRP rods adhered to each other so that rubber rod (1) and FRP rods (2) are integrated into a single body.

[0009]

Said rubber rod (1) should have a large permissible deformation degree such that it can undergo deformation to withstand damage, and it should have a high adhesive strength with FRP rods (2). Its diameter is φ30 mm, and its flexural rigidity is 27,000 kg/mm^2. For example, said FRP rods (2) may be drawn moldings of unsaturated polyester/glass fibers, with a diameter of φ3 mm and flexural rigidity of 17,000 kg/mm^2.

[0010]

In said application example, the present patent applicant compared a sample prepared according to this invention and a sample prepared by simply inserting four FRP rods into the rubber without adhesion between them (hereinafter to be referred to as comparative example) with respect to flexural rigidity. Results indicated that for the sample of the comparative example, the flexural rigidity is 95,000 mm^2, that is, it is simply the sum of the flexural rigidity of the four FRP rods (17,000 kg/mm^2 x 4) plus the flexural rigidity of the rubber rod (27,000 kg/mm^2), and there is no mechanical advantage at all. On the other hand, the sample of the application example has a flexural rigidity of 413,000 kg/mm^2, which is about 4.3-fold that of the comparative example (413,000 kgmm^2/95,000 kgmm^2). This clearly shows the effect of composition.

[0011]

Then, the flexural rigidity of the sample of said application example was compared with that of a single FRP rod having a diameter of φ7 mm and with a large cross-sectional moment of

inertia. The result indicated that the flexural rigidity of the single φ7 mm FRP rod is 385,000 kg/mm^2. This clearly indicates that with the constitution of the application example, the same or better flexural rigidity can be realized as compared with the φ7 mm FRP rod.

[0012]

In said application example, studies were made on the minimum bending radius at which bending damage takes place for the sample of this invention and a single φ7 mm FRP rod. It was found that for the φ7 mm FRP rod, the minimum bending radius r = 204 mm. On the other hand, for each of the φ3 mm FRP rods used in the application example, the minimum bending radius r = 77 mm, while for the sample prepared in the application example with four said φ3 mm FRP rods integrated with the base material, it is estimated that damage [does not] take place (that is, it does not break) at least when the bending radius r = 204 mm. That is, the sample of this invention has a higher tolerance to bending than the φ7 mm FRP rod.

[0013]

That is, for the rod-shaped reinforcing elastic member of this application example, since FRP rods (2) pretreated for adherence and used as the core member are buried in the axial direction and adhered to each other, the flexural rigidity of the composition becomes higher than that of a sample prepared by simply bundling four FRP rods. This indicates the effect of the composition of rubber rod (1) and FRP rods (2). In addition to this advantage of the composite member, it can exhibit the same flexural rigidity, that is, cross-sectional moment of inertia, as that of a single large-diameter FRP rod, and a higher tolerance to bending as compared with the large-diameter FRP rod. Consequently, the obtained rod-shaped reinforcing elastic member of this invention can be used preferably in pond frames, piers, flag poles, etc., which require high rigidity for flexural deformation and high tolerance to bending.

[0014]

Also, this invention is not limited to the aforementioned application example. One can employ various amendments and changes for the aforementioned application example, as long as the gist of this invention is observed. For example, in the aforementioned application example, four FRP rods are used. However, when isotropic properties are required for the rod-shaped reinforcing elastic member, one may also use three or seven FRP rods set at symmetric positions as shown in Figures 2(a), (b). Also, when anisotropic properties are required for the rod-shaped reinforcing elastic member, one may use two FRP rods. In this case, the two FRP rods may be set side-by-side in the longitudinal direction or lateral direction as shown in Figure 3(a) to realize different rigidity. Also, as shown in Figure 3(b), three FRP rods may be set side-by-side in a row

and said effect can be displayed even more significantly. In this way, by changing the number of FRP rods as well as their configuration of setting, one can realize any desired design corresponding to the required flexural rigidity and bending tolerance. Also, one can freely select the length and diameter.

[0015]

Also, by appropriately selecting the type of rubber used, or by reinforcing the rubber portion with reinforcing fibers, one can realize designs with excellent rotting resistance, weatherability, waterproof property, and other properties.

[0016]

Effect of the invention

As explained above, for the rod-shaped reinforcing elastic member of this invention, a composite effect, that is, a high flexural rigidity, can be realized for a rubber rod and fiber-reinforced plastic rods. Also, in addition to this advantage of the composition of the rubber rod and the fiber-reinforced plastic rods, one can realize a large cross-sectional moment of inertia, that is, one can obtain a rod-shaped reinforcing elastic member with the same flexural rigidity as that of a large-diameter fiber-reinforced plastic rod, and with a higher tolerance to bending than said large-diameter fiber-reinforced plastic rod. Consequently, the rod-shaped reinforcing elastic member of this invention can be used preferably in pond frames, piers, flag poles, etc. that require high rigidity for flexural deformation and high tolerance to bending.

[0017]

Also, by adjusting the number of fiber-reinforced plastic rods and their setting configuration, one can realize a desired design corresponding to the required flexural rigidity and permissible deformation degree to bending. Also, one can freely select the length and diameter, as well as the type of rubber, and one can reinforce the rubber portion with reinforcing fibers. As a result, one can realize excellent rotting resistance, weatherability, waterproof property, and other durability properties.

<u>Brief description of the figures</u>

Figure 1 is a cross-sectional view illustrating a rod-shaped reinforcing elastic member in an application example of this invention.

Figure 2 is a cross-sectional view illustrating a rod-shaped reinforcing elastic member in another application example of this invention.

Figure 3 is a cross-sectional view illustrating a rod-shaped reinforcing elastic member in yet another application example.

Explanation of symbols

1 Rubber rod

2 FRP rod

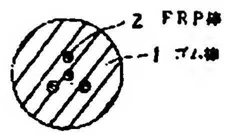


Figure 1

Key: 1 Rubber rod
2 FRP rod

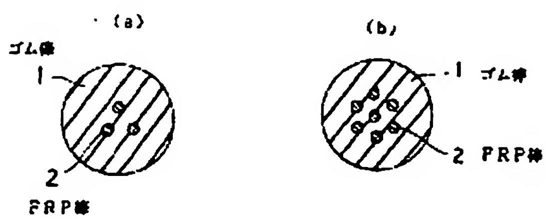


Figure 2

Key: 1 Rubber rod
2 FRP rod

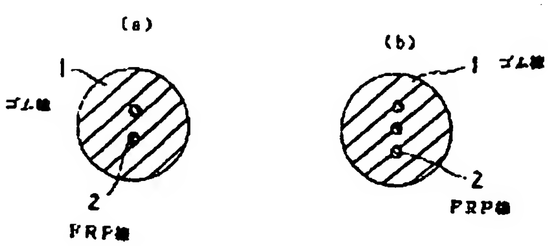


Figure 3

Key: 1 Rubber rod
2 FRP rod